M441U Installation Manual

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1 Disclaimer of Liability and Limitation of Warranty

Where the M441U is supplied as a component and not as part of a complete control system it is assumed that the purchaser has sufficient electrical and electronic knowledge to handle the component competently.

It is further assumed that the purchaser has sufficient knowledge of safe working practices and the relevant Health & Safety regulations which apply to working with electrical and electronic systems to work safely with the component.

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2 M411U card

The M441U card will fit inside you machine. It is fitted with a ribbon cable to allow it to connect to the existing control card. Ideally the 9-pin D-connector should be mounted to the outside of the machine cabinet so that the serial cable can be plugged or unplugged as necessary.

The 4 switches on the card are...

Switch	Function
1	Firmware update. If this switch is on the card will be forced into bootstrap mode. Do not use unless instructed to by a service technician.
2	Off - M441-3/Conect, On - D&M or Colne
3	Off - M441-3/Conect or D&M (depending on #2), On - Colne
4	reserved

So for...

- M441-3 or Conect - switches #2 and #3 off
- D&M - switch #2 on and switch #3 off
- Colne - switches #2 and #3 on

...in all cases switches #1 and #4 should be off.

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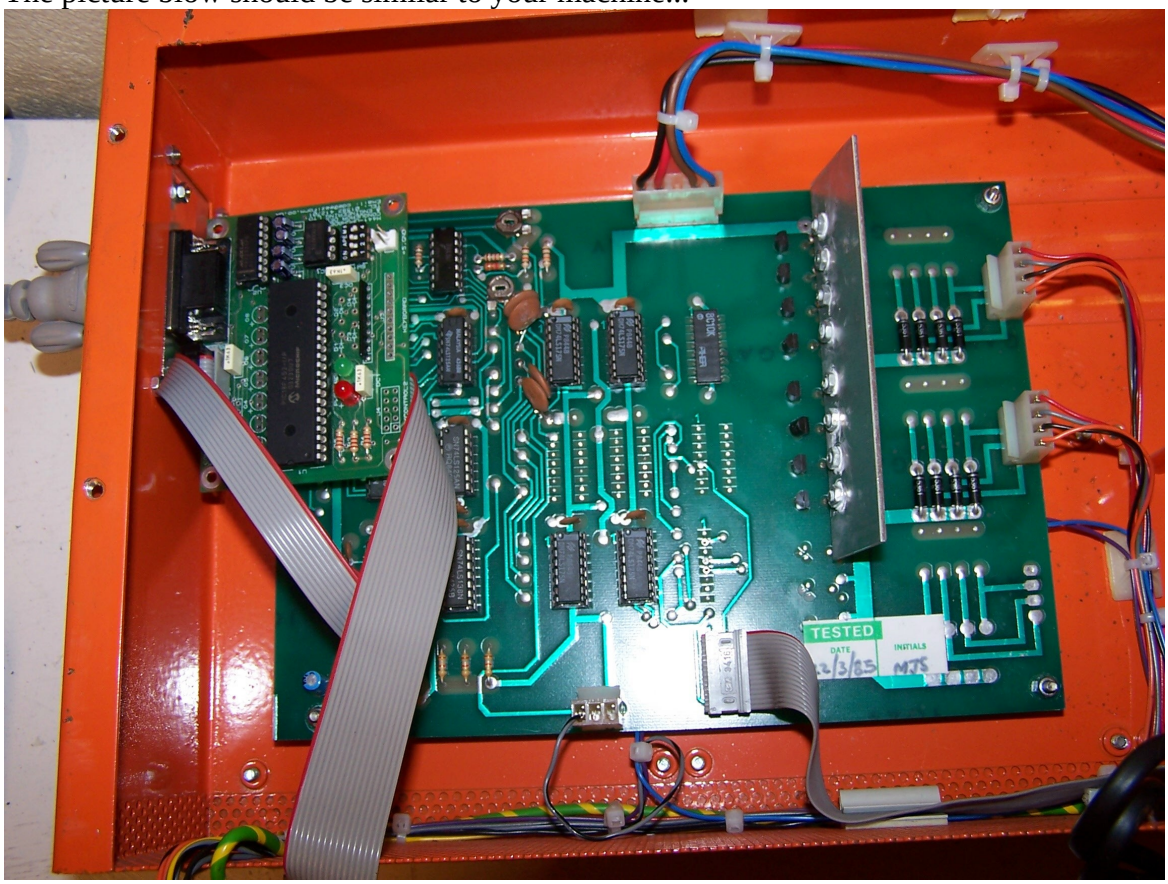
3 Installation

3.1 Installing the M441U

Installing the card - Colne...

The picture blow should be similar to your machine...



On some machines the 10-pin connector on the control card is routed to the outside of the cabinet as a 20-pin connector and housed in a plastic box. If you remove the plastic box you will find the required 10-pin connector on the board.

The serial cable supplied should be used to connect the 9-pin D-connector from the upgrade card to a free serial port on your computer.

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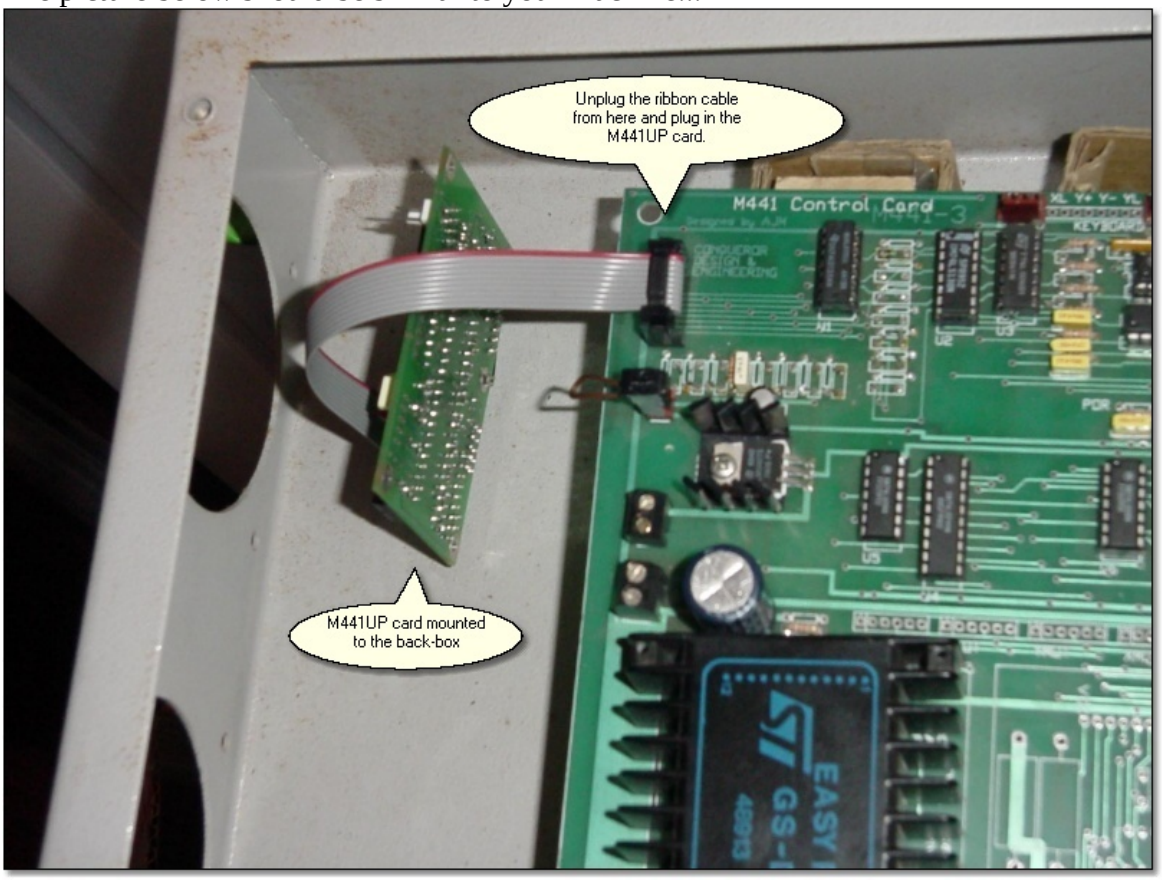
Installing the card - Conect...

The picture below should be similar to your machine...



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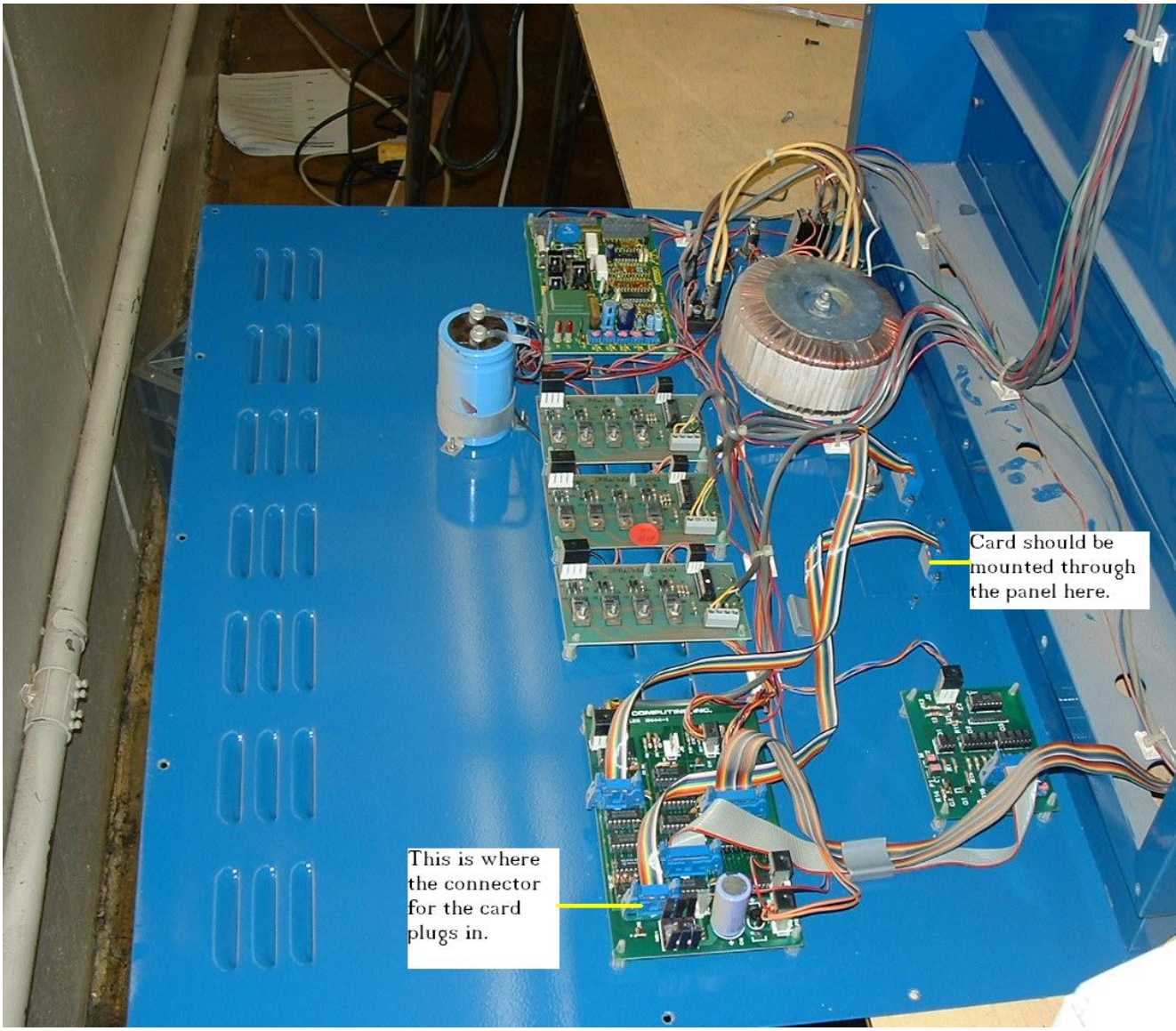
Installing the card - D&M…

The picture below should be similar to your machine…



The connector from the card is keyed so it should not be possible to connect it the wrong way round. If the card is connected correctly then when power is applied to the machine both the red and green LEDs will light up.

The serial cable supplied should be used to connect the 9-pin D-connector from the upgrade card to a free serial port on your computer.

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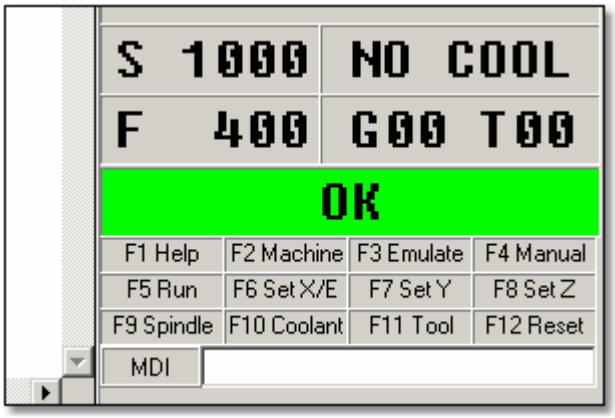
3.2 Configuring the software

The first step in configuring the software for use with your mill is to establish what type of front panel is connected to the mill. There were two types of front panel supplied… one type has 6 buttons for <X+>, <X->, <Y+>, <Y->, <Z+> and <Z-> control together with an <Enter> button. The other type has two rocker-switches for X+/X- and Y+/Y- control… the 3rd axis is controlled by pressing a <Shift> key and then using the rocker for Z+/Z-.

Install the software on your computer and then follow the instructions in the manual for selecting the correct serial port. When the correct port is selected then the status line on the software screen should change from red to green.



Enter the manual mode by pressing **<F2> - Machine** and **<F4> - Manual**.

Move the tool around using the jog buttons or rocker switches on the front panel. At this stage do not worry if the tool travels in the wrong direction when the button is pressed just be sure that when a + button is pressed the coordinate on the screen increases and when a – button is pressed the coordinate on the screen decreases.

If the panel buttons do not work as you would expect or you are unable to move one of the axes then you will need to write down the key values (as described below) and send them to me. I will then update the software with a new version of the firmware.

If the axes all move as expected then decide if the tool is travelling in the directions that you would expect… the X axis is left negative and right positive as you look at the machine, the Y axis is negative towards you and positive away from you and the Z axis is negative down and positive up. Please note that this is the relative movement of the tool and NOT the table so, for instance, when the tool is moving Y+ then the table will actually be coming towards you.

If any of the axes are reversed then the relevant bit in the control parameters will need to be set to reverse that axis. See the sections ‘Control parameters’ and ‘Setting Controls Parameters’ in the manual.

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3.3 Final configuration...

The parameters are currently set assuming that the machine is fitted with imperial lead-screws. If this is not the case then the parameters will need to be changed to suit metric lead-screws.

For a D&M3/4 The parameters should be as follows…

Parameter	Imperial/inch screw	Metric/Millimetre screw
8 (X-scale)	160	160
9 (X-divisor)	127	100
10 (Y-scale)	160	160
11 (Y-divisor)	127	100
12 (Z-scale)	160	160
13 (Z-divisor)	127	100
14 (E-scale)	160	160
15 (E-divisor)	127	100
16 (feed scale)	130	160
17 (feed divisor)	60	60

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4 Direct control via the RS232

It is possible to control the M441U directly from the serial port without using the EaziCNC or EaziCNCLite programmes.

The M441U accepts a subset of the full set of G & M codes (for instance no circular interpolation, no splines and no canned cycles) that EaziCNC supports, coordinates need to be in millimetres and only absolute positioning is supported. Also you need to deal with the handshaking from the machine to make sure that commands do not get overwritten before they can be executed.

To test this from, for instance, HyperTerminal...

1. Open a connection to the M641 at 115200 baud, 8 data bits, no-parity and 1 stop bit with Xon/Xoff handshaking.
2. Type <CTRL+E>... this will turn on the echo so that you can see the keys typed and the responses from the M641. You should also turn on the option to add line-feeds to carriage returns (*N.B. <CTRL+N> turns the echo off... the controller will not send anything back via the RS232 that is not requested... this keeps the interface 'clean' for very rapid communication from a programme like EaziCNC*).
3. If you hit <Enter> you should see the '>' prompt.
4. You can now enter commands such as 'ST' to show the status, 'M3' to turn on the spindle and 'G0 X10' to move (before you do any moves you may need to send an 'EC' to clear the error-state... by default the controller will power-up with error #3 - power-on).
5. If you want to see a rolling display of the coordinate changes as a movement command is executed then enter 'D1' (and 'D0' to turn the feature off).
6. The controller will send status information back to a control programme if certain characters are sent... for instance sending a '@' will return X, Y, Z and E positions, the key panel code and a status byte as a packed hexadecimal string. There are other codes which will return information from the box either as text, packed hexadecimal or binary-blobs.

In the raw 'terminal' mode any axis commands (such as 'X10' or 'Y1.26') will be interpreted as millimetres using the parameters to convert them into an accurate number of steps... the coordinates shown by the status commands are also shown in millimetres with 2 decimal places (0.01) but no decimal points are shown. Any of the commands that return data in a packed format return the raw step values.

There are a couple of ways to go depending on how sophisticated your control of the machine needs to be... you can either write your own interface to the controller which sends commands out of the serial port direct *or* there is a DLL available which contains a 'virtual'-machine that supports all of the commands that EaziCNC does and that can be easily integrated into any programme. The DLL takes care of all the serial communication to the machine and exposes a command function and a query function to the calling programme.

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5 Appendices

5.1 G-Codes

G-Code	Parameters	Description
G00*	X, Y, Z, E	Rapid Move
G01*	X, Y, Z, E, F	Feed Move
G02*	X, Y, Z, E, I, J, K, F, R	Arc Clockwise Move
G03*	X, Y, Z, E, I, J, K, F, R	Arc Counter-Clockwise Move
G04	S	Dwell. S=Seconds to delay.
G06*	X, Y, Z, E, A, B, C, D, P	Spline functions (Cubic curve) (only available when running with the EaziCNC software)
G07*	X, Y, Z, E, A, B, C, D, I, J,K, L, P	Spline functions (Bezier curve) (only available when running with the EaziCNC software)
G17	-	Use XY plane for circular interpolation (Top)
G18	-	Use XZ plane for circular interpolation (Front)
G19	-	Use YZ plane for circular interpolation (Side)
G28	X, Y, Z, E	Home Axis
G40	-	Tool-nose compensation off (default mode)
G41	R	Tool-nose compensation Left-of-Line
G42	R	Tool-nose compensation Right-of-Line
G43	-	Tool-length compensation (positive)
G44	-	Tool-length compensation (negative - default mode)
G45	-	Cancel Tool-length compensation.
G54	X, Y, Z, E	Set home/reset position.
G70	-	Imperial coordinates (only available when running with the EaziCNC software)
G71	-	Metric coordinates (default mode)
G90	-	Absolute coordinates (default mode)
G91	-	Incremental coordinates (only available when running with the EaziCNC software)
G92	X, Y, Z, E	Set datum point.

N.B. The E axis can also be programmed as U.
*N.B. The codes marked with * are modal. Modal codes are active on any subsequent lines that do not have a code given.*

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5.1.1 Additional G-Codes for Lathe Operations

G-Code	Parameters	Description
G33	X, Z, P, I	Threading(/synchronized) cut. P is pitch, I is end pull-out in X.
G80	-	Cancel Canned Cycle
G81*	X, Z, P	Turning cycle
G82*	X, Z, P	Taper cycle
G83*	X, Z, I, K, R, P	Arc Clockwise Cycle
G84*	X, Z, I, K, R, P	Arc Counter-Clockwise Cycle
G85*	X, Z, P	Facing Cycle
G86*	X, Z, P, I, K, R	Threading(/synchronized) cut cycle. X is pass offset (pass depth). P is pitch, I is end pull-out, K is pass offset in Z and R is number of passes.
G94	-	Feed rates in mm./in. per minute
G95	-	Feed rates in mm./in. per spindle revolution
G96	-	Constant surface speed. Feed rate specified in mm. at 20.0 mm. diameter. Feed rate specified in inches at 1.0 inch diameter.

N.B. The E axis can also be programmed as U.

*N.B. The codes marked with * are modal. Modal codes are active on any subsequent lines that do not have a code given.*

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5.1.2 Additional G-Codes for Milling Operations

G-Code	Parameters	Description
G50	-	Mirror Off. Cancel any mirrored axis.
G51	X, Y, Z, E	Mirror. Mirror selected axis (around coordinate given).
G55	-	Offset Off. Cancel/Clear temporary origin
G56	X, Y, Z, E	Offset. Set temporary origin.
G80	-	Cancel/Complete Canned Cycle.
G81*	Z	Drill, Spot-Drill
G82*	Z, K	Peck Drill
G83*	Z, P	Tapping
G84*	Z	Bore
G85*	Z, P	Pocket cycle.

N.B. The E axis can also be programmed as U.
*N.B. The codes marked with * are modal. Modal codes are active on any subsequent lines that do not have a code given.*

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5.2 M-Codes

M-Code	Parameters	Description
M00	-	Programme Stop
M01	-	Optional Stop
M02	-	Programme End (same as M30)
M03	S	Spindle Start Clockwise
M04	S	Spindle Start Counter-clockwise
M05	-	Spindle Stop
M06	R, T, X, Y, Z	Tool Change
M08	-	Coolant On
M09	-	Coolant Off
M13	S	Spindle Start Clockwise + Coolant On
M14	S	Spindle Start Counter-clockwise + Coolant On
M15	-	Spindle Stop + Coolant Off
M30	-	Programme End (same as M02)
M47	R	Return to Programme Start. R is the repeat count (if given)
M90	P	Relay P On
M91	P	Relay P Off
M92	P	Wait for input P to be Low
M93	P	Wait for input P to be High
M94	-	Index tool-post. Indexes the tool-post (if fitted) forward.
M98	-	Motor Drives On
M99	-	Motor Drives Off

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5.3 Command Set

Command	Parameters	Description
Ctrl-B (#2)	-	Query. Used by the EaziCNC software.
Ctrl-E (#5)	-	Echo On. Echoes characters back to the terminal and enables user friendly responses (data sent to the terminal will have a tag, i.e, "P0:0" instead of just "0").
Ctrl-N (#14)	-	Echo Off. Stops characters from being echoed back to the terminal and disables user friendly responses.
<ESC>	-	Escape. Stops any current moves or commands. Clears the command buffers. This command does not need to be completed with a carriage return (CR).
@	-	At. Returns the current position and status data in compressed hex format. This command does not need to be completed with a carriage return (CR).
D	n<CR>	Message-mode. Controls whether messages are sent to the console. n=0 - do not show messages n=1 - show messages (including updates when moving) n=2 - debugging mode
EC	-	Error Clear. Clears any error state on the machine. *N.B. this clears user-stops, power-up errors, etc. it will not and cannot clear errors such as 'safety activated'.*
ES	-	Error Status. Displays the error code of the machine. Error codes... 0 - No error 1 - Stopped by user 2 - Stopped - safety activated 3 - Power interrupted 4 - X-limit triggered 5 - Y-limit triggered 6 - Z-limit triggered 7 - E-limit triggered
I	n<CR>	Info. <n> is the item of information 0 - board ID 1 - firmware version 2 - firmware date 3 - processor type <blank> - firmware banner

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MA	<CR>	Manual Mode. To exit manual mode the <ESC> command must be sent.
P	n[Rv]<CR>	Parameter. Query (or set) a parameter. See control parameters for a description. P99 will display parameters 0 to 19, P199 will display parameters 20 to 39 and P299 will display parameters 40 to 59.
SX	f<CR>	Set X coordinate to <f>
SY	f<CR>	Set Y coordinate to <f>
SZ	f<CR>	Set Z coordinate to <f>
SE	f<CR>	Set E coordinate to <f>
SH	<CR>	Show Home. Displays the currently set home/starting position (set by a G54 command).
ST	<CR>	Status. Show current status.
T	X, Y, Z	Set/display tool offset. If no X, Y or Z is given then the existing offset will be displayed. T99 will list all tool offsets.

Any valid ISO line will also be interpreted and executed on the machine tool. For a list of valid ISO (G&M-codes) see G-Codes and M-Codes.

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5.4 Control Parameters

Parameter	Type	Description
0	Binary	Configuration 1 - see detailed explanation below.
1	Binary	Configuration 2 - see detailed explanation below.
2	Integer	Minimum Spindle Speed. Default=200 RPM
3	Integer	Maximum Spindle Speed. Default=2000 RPM
4	Integer	Maximum Cutting Feed Rate. Default=400 mm./min.
5	Integer	Rapid Feed Rate. Default=800 mm./min.
6	Integer	Pulses/Revolution on Threading/Synchronizing Encoder. Default=360 [Setting this to 0 will cause the slots to be counted]
7	Integer	Default Circular Interpolation Mode. 0=XY, 1=XZ, 2=YZ.
8	Integer	X-scale (X-step size in millimetres = (P9/P8)/P19)
9	Integer	X-divisor (X-step size in millimetres = (P9/P8)/P19)
10	Integer	Y-scale (Y-step size in millimetres = (P11/P10)/P19)
11	Integer	Y-divisor (Y-step size in millimetres = (P11/P10)/P19)
12	Integer	Z-scale (Z-step size in millimetres = (P13/P12)/P19)
13	Integer	Z-divisor (Z-step size in millimetres = (P13/P12)/P19)
14	Integer	E/U-scale (E-step size in millimetres = (P15/P14)/P19) Also used for V & W
15	Integer	E/U-divisor (E-step size in millimetres = (P15/P14)/P19) Also used for V & W
16	Integer	Scalar for Feed rates. Steps/sec=625,000*P17/(Feed*P16).
17	Integer	Divisor for Feed rates. Steps/sec=625,000*P17/(Feed*P16).
18	Integer	Decimal digits in coordinates. Default=2 digits

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19	Integer	Divisor for coordinates. Default=100
20	Binary	Control capabilities (see detailed description below). Do not alter!
21	Integer	Delays for carousel tool post. Forward delay = (low byte + 1)*0.25 secs Reverse delay = (high byte + 1)*0.25 secs [For stepper driven carousels 32768 (high bit) + steps/100. Reverse is half of forward steps]
22	Integer	Time-out for manual mode and automatic motor turn-off
23	Integer	Ramp stages (Maximum 16)
24	Integer	Ramp 0
25	Integer	Ramp 1
26	Integer	Ramp 2
27	Integer	Ramp 3
28	Integer	Ramp 4
29	Integer	Ramp 5
30	Integer	Ramp 6
31	Integer	Ramp 7
32	Integer	Ramp 8
33	Integer	Ramp 9
34	Integer	Ramp 10
35	Integer	Ramp 11
36	Integer	Ramp 12
37	Integer	Ramp 13
38	Integer	Ramp 14
39	Integer	Ramp 15
40	Integer	Back-lash compensation for X axis (steps)
41	Integer	Back-lash compensation for Y axis (steps)
42	Integer	Back-lash compensation for Z axis (steps)
43	Integer	Back-lash compensation for E/U axis (steps)
44	Integer	Back-lash compensation for V axis (steps)
45	Integer	Back-lash compensation for W axis (steps)
46	Integer	Low byte - deadband for X, high byte - deadband for Y

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47	Integer	Low byte - deadband for Z, high byte - deadband for E/U
48	Integer	Low byte - deadband for V, high byte - deadband for W
49	Integer	Max. encoder failure count allowed
50	Integer	X-encoder scale
51	Integer	X-encoder divisor
52	Integer	Y-encoder scale
53	Integer	Y-encoder divisor
54	Integer	Z-encoder scale
55	Integer	Z-encoder divisor
56	Integer	U/V/W-encoder scale
57	Integer	U/V/W-encoder divisor
58	Integer	Reserved
59	Integer	Reserved

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Configuration 1 (parameter 0)

bit 1	X axis direction
bit 2	Y axis direction
bit 3	Z axis direction
bit 4	E axis direction
bit 5	X axis home direction
bit 6	Y axis home direction
bit 7	Z axis home direction
bit 8	E axis home direction
bit 9	Turn off motor drives when inactive
bit 10	Override Safety switch (spindle and coolant will not run)
bit 11	Override Safety switch (spindle and coolant will run). MPC4 & MPC5 only.
bit 12	LED4 shows busy state (MPC4/MPC5 only)
bit 13	RELAY4 is reserved for motor reverse (MPC4/MPC5 only)
bit 14	tool carousel on motor E. [delay is (param21+1)*0.25 secs]
bit 15	Separate direction outputs for X, Y, Z & E (M640 only)
bit 16	Enable hand-wheel to be used for feed-rate override

Configuration 2 (parameter 1)

bit 1	X feedback active
bit 2	Y feedback active
bit 3	Z feedback active
bit 4	E feedback active
bit 5	X limit active
bit 6	Y limit active
bit 7	Z limit active
bit 8	U limit active
bit 9	X limit positive is NC (normally closed)
bit 10	X limit negative is NC (normally closed)
bit 11	Y limit positive is NC (normally closed)
bit 12	Y limit negative is NC (normally closed)
bit 13	Z limit positive is NC (normally closed)
bit 14	Z limit negative is NC (normally closed)
bit 15	U limit positive is NC (normally closed)
bit 16	U limit negative is NC (normally closed)

Control Capabilities (parameter 20)

bit 1	0 - Control does not support G2/G3 directly 1 - Control supports G2/G3 directly
bit 2	reserved
bit 3	reserved
bit 4	reserved

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bit 5	reserved
bit 6	reserved
bit 7	reserved
bit 8	reserved
bit 9	reserved
bit 10	reserved
bit 11	reserved
bit 12	reserved
bit 13	reserved
bit 14	reserved
bit 15	reserved
bit 16	reserved

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